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XVII. EXPERIMENTS UPON THE CONTROL OF THE REFLEX WINK.

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The best description of the problem of the following study is the incident that suggested it. A party of visitors was standing before one of the snakes' cages in Central Park, New York, watching the cobras strike against the glass. One of the party noticed that every one jumped back when the snakes struck. After their attention had been called to the involuntary movements several tried to hold the face near the glass and to prevent the reflex start, but none could control it. Doubtless with sufficient practice all or nearly all would have succeeded, but the psychophysical problem remains of how they would have attained their success—a problem of obvious importance for both psychology and pedagogy. After considerable preliminary experimenting the control of the reflex wink was finally selected as presenting the same general problem, and special apparatus was devised for exciting it. The first arrangement was as follows: The subject was seated with his forehead and chin supported by a suitable head rest. Close before his face was brought a framed piece of thick plate-glass about six by eight inches in size. On the back side of this glass and attached to the lower side of the frame was a small rubber-faced wooden-headed hammer which, when released from a catch under the control of the experimenter, was swung suddenly upward, and struck the glass about the level of the eyes of the subject. With the instrument in this form experiments were made on several members of the university and others. In a later form of the instrument, however, the head rest and glass plate were both attached to a graduated steel rod (supported on legs and standing on a table) so that the glass and striking apparatus could be set at any required distance from the subject, while the distance could be read in centimetres. The subjects generally knew the nature of the experiment to be made upon them, and were simply requested to refrain from winking.¹ In the experiments on school children, made with the revised instrument, a

¹ [The stroke of the hammer against the glass was, of course, by no means noiseless, and there was also a little tremor and rattle of the apparatus attending the blow. These must not be neglected in estimating the results of the experiments; indeed, it seems to me that the vision of the swiftly moving hammer was, perhaps, a less important factor in producing the wink than the sound of its stroke on the glass. E. C. S.]

card placed some distance away and at about the height of the subject's eyes, was used as a fixation point.

From the nature of the experiment the operator was obliged to judge for himself not only whether a wink had taken place, but also, after the subject had ceased to wink, whether the control was fairly perfect or merely temporary. In the earlier cases in the schools a good many hammer-strokes were given after the winking had ceased, but as the operator became more expert in recognizing the signs of easy control, the number of such extra tests was decreased. In no case, however, was the testing ended till the subject had been able to inhibit several winks in succession, with the appearance of being able to continue the inhibition indefinitely.

In the experiments with the university men it was soon discovered that there were the greatest differences among normal adults in the power of control of the wink. The earlier subjects were tested with the glass close to the face and without a special fixation point. The lever was released at fairly regular intervals, but of course without warning. Some were able to control the reflex movement after four or five trials and during a long series there was either no trace of movement of the eyelids or only a very slight twitching, unless there was great variation in the intervals between the stimuli; while others were unable to inhibit the reflex even after long practice.

Two subjects who had difficulty in controlling the movement were given long series of tests in order to study the method of control, and its gradual perfection. Both subjects were men trained in psychological work but of nervous temperament. Subject A. was given a series of twenty-nine tests on alternating days, fifty trials in each test. During the first four days no winks were inhibited, and oftentimes the subject winked three or four times after a single hammer stroke. The course of improvement from day to day is shown by the following figures, which give the number of cases in each group of fifty trials in which the wink was inhibited: 0, 0, 0, 0, 5, 6, 0, 6, 11, 5, 10, 10, 17, 17, 32, 21, 21, 15, 26, 16, 41, 16, 22, 23, 15, 27, 21, 32, 25. Summing these in groups of four, gives the following: 0, 17, 36, 87, 78, 102, 95. With this subject the reflex was prevented best by neglecting the stimulus altogether, and not trying to prevent the wink by contracting opposing muscles. He usually fixated some point considerably beyond the glass, and watched it attentively. Change in rhythm of releasing the lever, a peculiar rhythm, or a short interruption in the series, lessened his control. Physiological condition seemed also to affect the results; after long continued work at his desk his control was lessened.

Subject B. had twenty-seven tests of one hundred trials each.

The number inhibited each day was as follows: 0, 0, 2, 4, 4, 0, 8, 2, 6, 4, 0, 28, 8, 4, 21, 32, 65, 39, 81, 83, 77, 92, 86, 97, 99, 88, 98. Summing these in groups of four gives the following: 6, 14, 38, 65, 268, 352. Subject B. also did best when he fixed his eyes on a distant point and was passive.

Three experiments were made to test the effect of alcohol upon control. A subject who had previously been given ten tests of one hundred trials each, in which he had averaged thirty-two inhibitions, received forty-five grams of alcohol, and five minutes later was retested. Three hundred trials were made in groups of fifty. He winked four times in the first group, but in all other trials the winks were inhibited. On subsequent normal days the subject relapsed toward his former condition. Two tests were also made with intoxicated subjects. Both these showed a decided improvement in control as the effect of alcohol.

After the apparatus had been arranged to allow variation of the distance of the glass from the subject's face the test was made upon upwards of eleven hundred pupils of the Worcester schools.¹

The method was slightly different from that used with the adults. The child was seated with his face in the head rest of the apparatus and was given thirty-five trials with the plate at the zero point of the distance scale (about five centimeters from the eyes). If at the end of these thirty-five trials the wink was not under control the distance was increased by two centimeters and thirty-five more trials given. Then, if necessary, another thirty-five trials were given at the five centimeter mark, and afterward at 10, 15, 20, 30, 50, 80, 110, and even farther if the reflex had not sooner been brought under control. In this manner was determined for each child the number of winks, necessary before the reflex was mastered.² The children ranged in age from five to fifteen years, and included nearly equal numbers

¹ The writer desires to make grateful acknowledgments to the Worcester school authorities for permission to make the tests in the schools, and to the teachers and principals of the schools in which he worked for courtesies received, also to his wife who assisted in the experiments and in the work of tabulating the results.

² This method of computation neglects the element of distance in the final results (resting only on the number of winks), but is sufficiently exact for present purposes.

The number of winks was used rather than the number of trials, when the two did not agree, because in this way the child was given the benefit of any scattering successes occurring before he had gained complete control. A record like the following, for example—w w w w w o o o w w o o o o o o o (w=winks, o=successes)—would stand as a score of 7 against the child when winks are counted, but as a score of 10 when trials are counted. In most cases, however, there was no difference.

of boys and girls: Boys, 584; girls, 557.¹ The following table shows the number of each age tested, together with the least number of winks necessary in any case before control was secured, the median number and the greatest number necessary:²

TABLE I.

Showing the Number of Winks Necessary Before the Gaining of Control.

AGE.	BOYS.				GIRLS.			
	TOTAL CASES.	LEAST NUMBER.	MEDIAN.	GREAT'ST NUMBER.	TOTAL CASES.	LEAST NUMBER.	MEDIAN.	GREAT'ST NUMBER.
5	55	1	38	218	52	0	40.5	286
6	53	1	22	199	53	1	27	171
7	48	1	4	326	55	1	13	175
8	50	0	3.5	127	50	1	17.5	378
9	51	1	3	191	52	0	6	315
10	48	0	3	233	49	0	9	291
11	52	0	2	140	47	0	4	248
12	55	1	3	69	53	0	23	335
13	58	0	2	81	55	0	4	221
14	67	0	1	261	54	1	3	325
15	47	0	1	71	37	1	2	105

The table shows a gradual improvement with increasing age, most marked in the first four or five years, an index probably of growing control of the muscular system in general during these years and especially of the reflex mechanism. The improvement is both more marked and more uniform in the case of the boys than the girls, the reason for the difference lying probably in the fuller neuro-muscular training which the average boy receives from his freer life. The most marked deviation from uniform progress is in case of the girls of twelve years. The difference seems too great to be merely accidental, and yet the writer has been unable to discover a satisfactory explanation. That it was not due to the general conditions of the experiment seems clear from the relatively small difference in the case of boys of the same age. If the results are treated by averages instead of by medians the same general relations are obtained, though the irregularities are of course differently

¹ In getting the ages of the children no account of the months was taken. The age called "five" therefore extends from the fifth to the sixth birthday, and, similarly, that called "six" from the sixth to the seventh birthday, and so on.

² The median number is found by arranging all the cases in order, according to the number of winks recorded, and picking out the middle number in the series. When the number of cases is odd, some particular number will be found; when it is even, the average of the two numbers nearest is taken instead.

distributed. The average number of winks for the 584 boys irrespective of age is 19, and for the 557 girls 34.

Table II is arranged to show the distribution of cases according to success in controlling the wink. The whole number of cases for each age has been divided into eight groups according to the number of winks made before complete control was secured. The first includes all who winked four times or less, the second those who winked between five and nine times inclusive, the third those who winked between ten and nineteen times, and so on, till in the last group are found those who winked 300 times or more. These figures have finally been reduced to percentages for easier comparison. *B* in each case stands for boys and *G* for girls.

TABLE II.

Showing Distribution of Cases According to Success in Controlling the Wink.

AGE.		TOTAL CASES.	0-4 WINKS.	5-9 WINKS.	10-19 WINKS.	20-49 WINKS.	50-99 WINKS.	100-199 WINKS.	200-299 WINKS.	300-399 WINKS.
5	B	55	20.	10.9	12.7	20.	23.6	7.2	5.4	
	G	52	11.5	9.6	11.5	19.2	26.9	17.2	3.8	—
6	B	53	24.5	15.0	9.4	22.6	15.0	13.3	—	—
	G	53	20.6	16.9	9.4	24.5	18.9	9.4	—	—
7	B	48	56.2	8.3	8.3	18.7	4.2	—	—	4.2
	G	55	32.6	12.6	9.0	18.1	18.1	9.0	—	—
8	B	50	60.	12.	4.	6.	14.	4.	—	—
	G	50	34.	8.	10.	12.	32.	2.	—	2.
9	B	51	62.7	13.7	1.9	11.7	5.8	3.9	—	—
	G	52	46.1	13.4	5.7	13.4	13.4	3.8	1.9	1.9
10	B	48	66.6	12.5	2.0	12.5	2.0	2.0	2.0	—
	G	49	36.8	14.2	8.0	8.0	24.5	6.1	2.0	—
11	B	52	75.0	1.9	11.5	7.6	1.9	1.9	—	—
	G	47	53.0	6.3	—	16.9	10.5	8.4	4.2	—
12	B	55	65.4	10.9	5.4	14.4	1.8	—	—	1.8
	G	53	36.0	3.8	7.6	32.2	13.2	3.8	1.9	1.8
13	B	58	75.8	6.8	3.4	10.3	3.4	—	—	—
	G	55	56.3	3.6	5.4	21.8	7.2	3.6	1.8	—
14	B	67	76.1	4.4	2.9	4.4	9.0	1.4	1.4	—
	G	54	55.5	7.4	5.5	18.5	7.4	1.8	1.8	1.8
15	B	47	76.5	6.3	2.1	10.6	4.2	—	—	—
	G	37	70.2	10.8	2.7	10.8	2.7	2.7	—	—

The table shows very well the proportion of those who had difficulty in mastering the tendency to wink, and also the dif-

ference between the boys and girls. The actual number of boys in the first group (four winks or less) is 351, in all other groups 233; of girls in the first group 225, and all other groups 332. As in Table I the boys make the better showing, though individuals of both sexes are found in all the groups.

The children were tested partly in the forenoon and partly in the afternoon, but such differences as appear in the averages do not bring out any certain relation between time of day—to which fatigue might be supposed to be roughly concomitant—and the ability to control the wink. There seems also to be no marked relation between ability to control the wink and ability to take high rank in school work. Special tables prepared to test this relation are quite equivocal.

With the thought of discovering some relation between inability to control the wink and general "nervousness," the teachers were asked to indicate the children regarded by them as especially "nervous." Thirty-six boys and forty-seven girls were thus indicated. When the position of these cases is looked for in the classification of Table II it is found that sixteen of the boys and seventeen of the girls belong to the groups winking four times or less, of which groups they constitute 4.5 and 7.5 per cent. respectively. The remaining twenty boys and thirty girls winked five times or more and constitute respectively 8.6 and 9 per cent. of the whole number showing that degree of control. It would appear therefore that a boy described as "nervous" is rather apt to have difficulty in controlling the wink, but that a girl so described is but little more likely to have difficulty than one described as normal.

A similar question was asked about "dreamy and inattentive" pupils, and seventy-one boys and eighteen girls were so reported. Of the boys, forty appear in the first group of Table II, constituting 11.4 per cent. of the group, and 31 fall in the remaining groups, of which they form 13.3 per cent. Of the girls, seven appear in the first group and eleven in the remaining groups, forming about 3 per cent. in each case; showing little relation in either case between "dreaminess and inattention" and inability to control the wink. The proportion of boys and girls thus characterized by their teachers is, however, an interesting index of sex differences in school life.

The methods employed by the children to prevent the wink were various. In most cases tension of opposing muscles was first employed, the younger children sometimes tensing the muscles of the face, arms, legs and body, and even straining the fingers apart. As control was gained the muscle tensions were, of course, in general more definitely localized and lessened in degree. Many seemed to be unable to watch the fixation point, and such wandering attention was usually associated

with small power of control. In the case of some of the youngest children the effort to refrain from winking itself lapsed unless there was an occasional reminder. In a general way two types of good control could be distinguished, a nervous type with strong reflex tendencies, but equally strong control, and a stolid, fearless and somewhat inactive type with apparently less reflex excitability.

The following miscellaneous observations may also be recorded: Momentary changes in attention frequently inhibited a few winks in a series long before control was finally gained. Smiling seemed to be especially effective in temporarily inhibiting the reflex. Changes of any kind in the environment, as of some one entering the room, opening of a door, an unexpected sound, usually increased the tendency to wink, though in some cases such a distraction seemed to have the opposite effect. Some cases were observed in which, though the first few reactions were very violent, involving muscles of the whole body, final control was sooner gained than in cases where the reaction was less violent at the beginning. There appear to be great differences also in the rapidity of the wink, the eye being closed so rapidly in some cases as to make observation difficult, while in others the closure was noticeably slower.

In concluding, the writer may say that he feels that he has barely broken ground upon a subject of very great interest, and that the method here employed, or some modification of it, can yet be made to yield most interesting results in several other directions.